STANDARD &POOR'S INFRASTRUCTURE FINANCE

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Traffic Forecasting Risk: Study Update 2004

The traffic forecasting risk research carried out by Standard & Poor's Ratings Services has, to date, concentrated on optimism bias: its nature and extent. Empirical evidence suggests that toll road forecasts have, on average, overestimated traffic by 20%-30%.

The 2004 study update compares toll road forecasting performance with the predictive record of traffic forecasts made for toll-free facilities. Analysis of the toll-free forecasts demonstrates over- and underestimation in roughly equal proportions. Systematic optimism bias therefore appears to be a distinguishing feature of toll road forecasts.

Bias is only one component of traffic forecast inaccuracy, however. Another key component is general error, and in this respect traffic forecasting performance relating to toll facilities looks very similar to that for toll-free roads. This finding has implications for the interpretation of forecasts from roads that are free at the point of use. Shadow toll roads, for example, cannot be presumed to have reduced traffic risk simply because drivers' willingness to pay tolls does not have to be factored into the equation.

The decomposition of forecast inaccuracy into bias and error is important in the context of critically interpreting traffic forecasts. Standard & Poor's research supports the view that, before conducting sensitivity tests, base case forecasts should be adjusted to take account of any suspected optimism bias. A realistic base case traffic forecast with broad stakeholder buy-in is a necessary, but not in itself sufficient, prerequisite for critical credit analysis. Sensitivity tests should subsequently be used to assess the robustness of key credit metrics to alternative input assumptions. Only then will the true credit quality of a toll road's business proposition start to emerge.

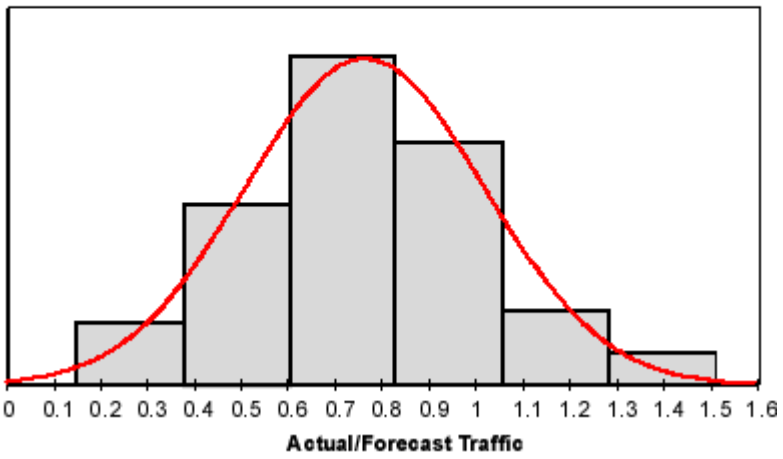
The 2004 Analysis

Chart 1 shows the traffic forecasting performance from the 2004 data set of 87 toll road projects. As in the two previous studies, the focus is on end-of-year-one data. The horizontal axis shows forecasting performance presented as a ratio of actual to forecast traffic. When traffic outperforms its respective forecast, this ratio is greater than one. Case studies where traffic forecasts have overestimated demand return ratios of less than one. The chart, an updated version of those presented in the two previous studies, with its suggested mean of 76%, supports our earlier conclusions that, on average, toll road traffic forecasts overestimate year-one traffic by 20%-30%.

Chart 1

Standard & Poor's Expanded Sample (2004)

Normal (0.76, 0.26)*n* = 87



The distribution is centered on 0.76, which is marginally higher than the average of 0.74 derived from the 2003 study. This difference is not statistically significant, however. The standard deviation (the "spread", measuring the variability in the data set), at 0.26, is large and identical to the 2003 findings. The range stretches from projects whose traffic was only 15% of the original forecast to projects that exceeded their forecasts by more than 50%.

Nineteen additional projects were considered this year, alongside the 68 included in the 2003 research. The projects examined for the first time are mainly tolled highway case studies from Europe and Australasia. Two new shadow toll roads have been added to the sample. As always, data were available for many more case studies but only 19 passed the key screening criteria:

- All data must be second-sourced for independent verification; and
- All data must allow for a comparative analysis on a like-for-like basis (i.e. there were no significant changes to the project, its design, or its implementation between the time that the forecasts were made and the end of year one of operations.

The addition of this new data supports Standard & Poor's earlier findings, enhancing confidence in our conclusions. Toll road traffic forecasts incorporate considerable uncertainty (as indicated by the wide range of performance) and systematic optimism bias.

Toll Roads Versus Toll-Free Roads: A Comparison of Forecast Accuracy

Until recently, much of the literature on traffic forecasting performance focused on individual projects rather than cross-sectional, large sample studies. In 2004, however, a Danish professor, Bent Flyvbjerg, reviewed the year-one forecasting performance from 183 road projects around the world, of which more than 90% are toll-free. At the time of writing, Professor Flyvbjerg's findings remain unpublished but he has given Standard & Poor's permission to use his traffic data for comparative purposes (see "Acknowledgement" at the end of this article).

Chart 2 presents Professor Flyvbjerg's results. It shows a wide range of forecasting performance. This range extends from actual traffic volumes 70% below their forecasts to outturn figures exceeding their respective predictions by more than 160%.

Chart 2

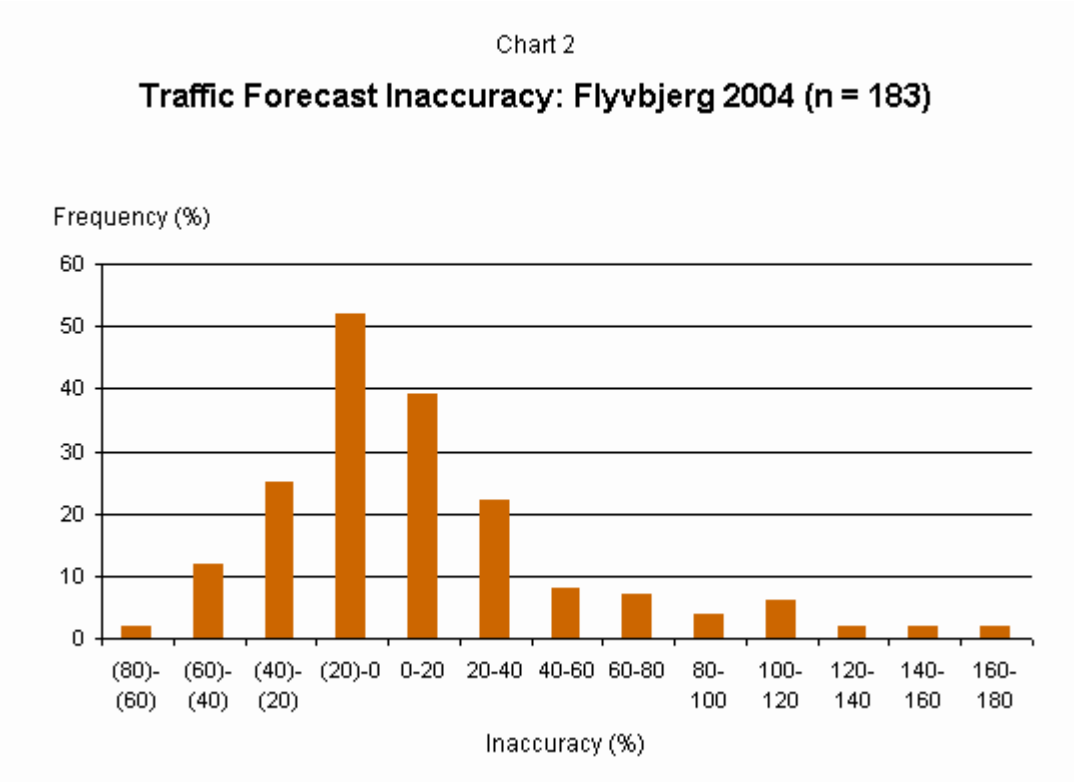
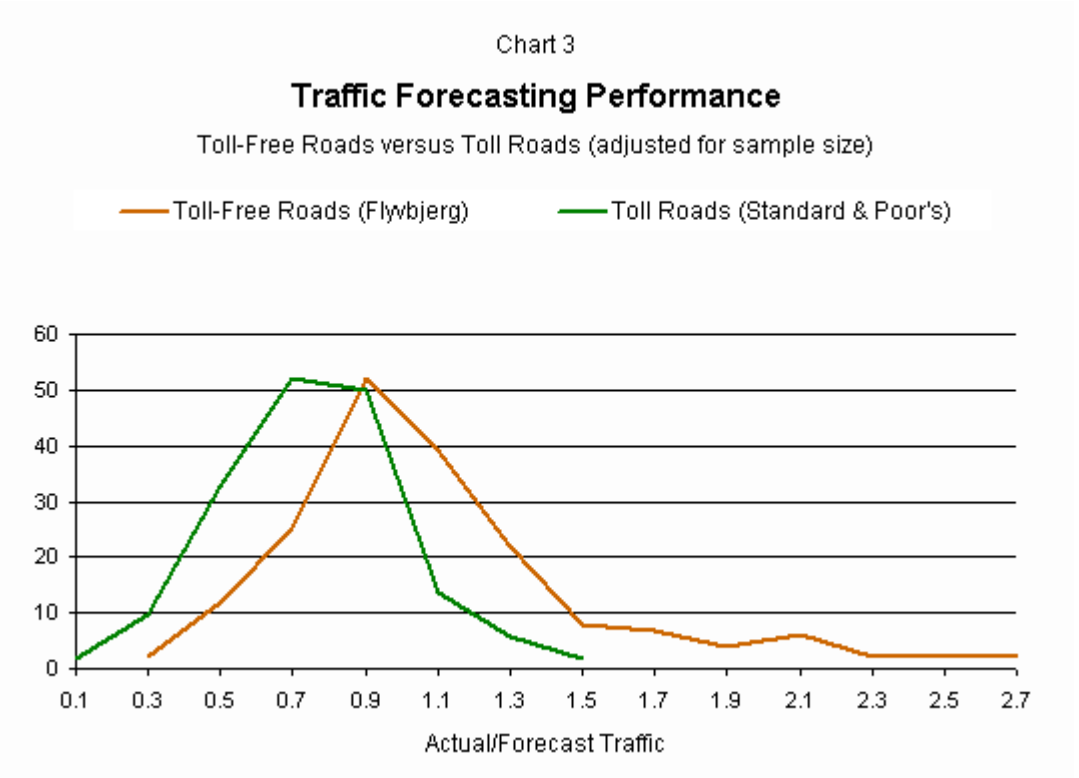


Chart 3 compares the results from the Flyvbjerg study with Standard & Poor's findings. The Flyvbjerg data was transformed to permit comparative analysis. The shape of the Flyvbjerg study's data distribution remains unchanged by this transformation. In addition, the Standard & Poor's data was normalized to take account of the sample size difference between the two studies. The shape of Standard & Poor's data distribution also remains unchanged by this transformation.

Chart 3



The error distribution for toll-free roads shows a long right-hand tail. This tail represents public sector road projects for which traffic was underestimated by

a considerable margin. The forecast performance distribution for the largely private sector toll roads does not have such a tail. This may be because toll road forecasts for private sector roads are prepared specifically to assess and exploit the commercial strengths of a business proposition. Considerable attention, therefore, is paid to any upside potential from these propositions, and so the likelihood of underestimation is significantly reduced.

Although long, the right-hand tail for toll-free roads actually represents very few projects; less than 7% of the toll-free data set exceeds its forecast by more than 100%. For these reasons, the remainder of this comparative analysis concentrates on the two bell-shaped distributions to the left of the chart, which reflect the majority of data observations.

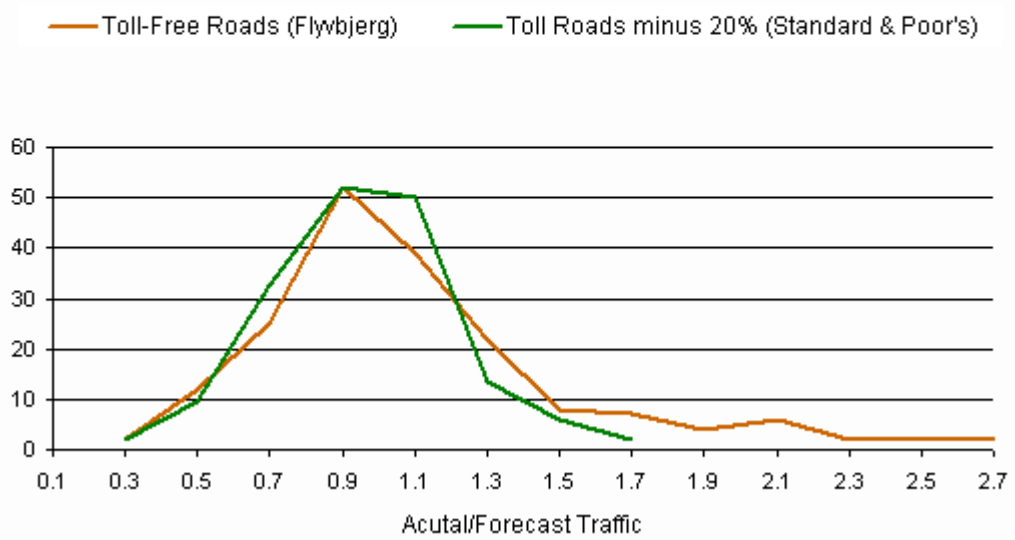
The bell-shaped distributions appear similar in terms of the extent of their "spread", which reflects the range of forecast errors. The toll road distribution, however, clearly sits to the left of the toll-free road distribution, by around 0.2, or 20%. This translates into a systematic 20% skew in toll road forecasts, consistent with the 20%-30% optimism bias identified earlier by Standard & Poor's. The similarity of the error distributions, however, appears to contradict the common assertion that traffic risk is automatically reduced where there is no point-of-use charging.

If the Standard & Poor's data sample is adjusted for 20% optimism bias, the shapes of the distribution of both data sets look remarkably similar, supporting the finding regarding similar error distributions. The adjusted distributions are shown in chart 4.

Chart 4

Traffic Forecasting Performance

Toll-Free Roads versus Toll Roads (adjusted for sample size and optimism bias)



Although considerable care needs to be taken with these early findings, this preliminary analysis suggests that, in terms of performance, after adjusting for optimism bias, there is little difference between the accuracy of forecasts prepared for toll roads and those prepared for toll-free roads.

Standard & Poor's Previous Research

In 2002, Standard & Poor's published for the first time the results of a study evaluating the outturn performance of toll road traffic forecasts (see "Credit Implications of Traffic Risk in Start-Up Toll Facilities", published on Aug. 15, 2002, on RatingsDirect, Standard & Poor's Web-based credit analysis

system). Our key conclusions focused on errors and optimism bias after the first year of operations. The error range was considerable, stretching from projects that had underperformed by 70% to projects that had overperformed by 20%. The error distribution was also skewed, suggesting the presence of systematic optimism bias. The mean error was negative 30%. On average, forecasts overestimated traffic demand by about 30%.

These preliminary findings were supported by further analysis conducted one year later (see "Traffic Forecasting Risk: Study Update 2003", published on Nov. 6, 2004, on RatingsDirect). The continual compilation of international traffic forecasting data and their respective original projections enabled the 2003 sample to be enlarged to 68 from 32 toll road projects. Analysis of the enlarged sample supported the conclusions of the original study and permitted some disaggregated research. Subsample analysis revealed that the error range and quantum of optimism bias were reduced in forecasts from countries where toll roads were well established. This suggested that there was less uncertainty about how drivers would respond to new toll roads in jurisdictions with a history of road tolling.

Acknowledgement

Standard & Poor's extends its gratitude to Professor Bent Flyvbjerg from Aalborg University in Denmark for permission to use his traffic forecasting performance data. Full details of Professor Flyvbjerg's studies and research findings are available on: http://www.plan.aau.dk/~flyvbjerg/.

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